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[Claim(s)]

[Claim 1]a fuel cell stack which laminates two or more single batteries formed using solid polymer electrolyte membrane -- or, A solid polyelectrolyte form fuel cell, wherein an electrical-insulation-properties fluid is filled in space which a fuel cell stack which laminates said two or more single batteries and two or more members for humidification is allocated in an inside of an airtight container, and encloses a fuel cell stack in this airtight container.

[Claim 2][in the solid polyelectrolyte form fuel cell according to claim 1] [said electrical-insulation-properties fluid filled in space in an airtight container] A solid polyelectrolyte form fuel cell provided with a circulation cooling system of an electrical-insulation-properties fluid which circulates between an airtight container and a heat exchanger installed out of an airtight container, and is made to cool in a heat exchanger.

[Claim 3]A solid polyelectrolyte form fuel cell being a circulation cooling system which it makes circulate through an electrical-insulation-properties fluid, and makes cool in the solid polyelectrolyte form fuel cell according to claim 2 when a circulation cooling system of the aforementioned electrical-insulation-properties fluid reaches more than working temperature with a specific temperature of a fuel cell stack.

[Claim 4]In the solid polyelectrolyte form fuel cell according to any one of claims 1 to 3, A solid polyelectrolyte form fuel cell to which said electrical-insulation-properties fluid is characterized by being either silicone oil which makes JIMECHIRU silicone or methylphenyl silicone the main ingredients or the fluorocarbon.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the composition of the fuel cell stack which was

excellent in electrical insulation properties and the heat recollection performance especially with respect to the solid polyelectrolyte form fuel cell constituted using solid polymer electrolyte membrane.

[0002]

[Description of the Prior Art]A solid polyelectrolyte form fuel cell (PEFC:Polymer Electrolyte Fuel Cell) is a fuel cell which uses a polymer membrane for an electrolyte, High power density's being obtained and working temperature. Since it has advantages, like it can start low with 100 ** or less in a short time, and an inexpensive material can be used, early utilization is expected and the 1-kW class [as an object for cars] battery is developed for tens of the kW class of battery as home use.

[0003]Drawing 5 is a mimetic diagram showing the basic composition of the general cell of a solid polyelectrolyte form fuel cell. [the film and the electrode zygote 20 (MEA:Membrane ElectrodeAssembly) constituted by allotting the anode side electrode layer 22 and the cathode side electrode layer 23 to both sides of the solid polymer electrolyte membrane 21] It pinches with the separator 26 provided with the anode side diffusion zone 24, the cathode side diffusion zone 25, and also the fuel gas conduction slot 28, and the separator 27 provided with the oxidant gas conduction slot 29, and the single cell 30 is constituted.

[0004]A fuel cell stack laminates two or more these single cells 30, and is constituted. Drawing 6 is a partial side view showing the example of composition of a fuel cell stack. Two or more single cells 30 are laminated, the collecting electrode plate 31 and the base plate 32 are arranged on the both sides, and it is pressurized and held from both sides with the spring 33. In a figure, the stud for [34] bolting in a clamping plate and 35 and 36 are nuts. the hydrogen which carried out property modification of pure water matter or the natural gas in this composition -- if fuel gas, such as rich reformed gas, and oxidant gas, such as air, are supplied to each single cell through the charging line which is not illustrated, the Electrochemistry Sub-Division reaction will be produced and generated. Since two or more laminated single cells make series connection electrically, between the collecting electrode plates 31 of both sides, the voltage of total of two or more single cells is obtained.

[0005]Although the composition of this figure is not shown, with two or more single cells 30, the member for humidification used in order to hold the solid polymer electrolyte membrane 21 to a damp or wet condition may be laminated, and a fuel cell stack may be constituted. Since reaction fever is produced while electric energy is obtained in the above-mentioned Electrochemistry Sub-Division reaction, in order to maintain temperature to predetermined working temperature, a fuel cell stack is cooled with refrigerants, such as cooling water.

[0006]Thus, although two kinds of reactant gas and a refrigerant are supplied and discharged by the fuel cell stack, in the solid polyelectrolyte form fuel cell, this supply and the internal manifold structure which arranges the manifold for discharge in the field of the members

forming of a fuel cell stack are usually used for it.

[0007]

[Problem to be solved by the invention]The solid polyelectrolyte form fuel cell is developed as mentioned above as moved type power generators the non-portable power generator of the cogeneration method which served also as extraction of the heat for hot-water supply, for cars, etc. Among these, in the non-portable power generator of a cogeneration method, in order to obtain the heat for hot-water supply as so much as possible, it is one of the problems of the utmost importance to stop the amount of heat dissipation from a fuel cell stack to the minimum. For this reason, although the method which covers a fuel cell stack severely with the thermal insulation which consists of glass fibers etc. is generally taken, it has been an obstacle when inclusion of this thermal insulation attains miniaturization of the whole power generator. Even if it covers severely with thermal insulation, it is difficult to make the heat which dissipates from the crevice and the surface of thermal insulation there be nothing, and it has been a technical problem how thermal efficiency is raised.

[0008][the internal manifold method generally adopted] Since the exposed part of the side of a fuel cell stack is large as compared with the external manifold method which attaches a manifold to the lateral surface of a fuel cell stack, When the structure covered with thermal insulation is adopted, when prolonged operation is stopped, thermal insulation absorbs moisture, two or more cells short-circuit partially, and there is a danger that performance falls. In order to avoid this danger, it is necessary to fully secure the crevice between a fuel cell stack and thermal insulation but, and if crevice sufficient in this way is taken, miniaturization of a power generator and improvement in thermal efficiency will become still more difficult.

[0009]Since it constitutes from a solid polyelectrolyte form fuel cell used as moved type power generators for cars etc. compactly and electric power generating density is raised on the other hand, the density of the reaction fever to generate is high and it is one of the important problems to radiate this generating heat outside efficiently. Although the method which hits air simply and is cooled can take in a common internal-combustion engine, when this method is adopted as a solid polyelectrolyte form fuel cell, there is a danger of moisture in the air, salt, metallic particulates, etc. adhering to a fuel cell stack, and causing a short circuit. Therefore, in a moved type solid polyelectrolyte form fuel cell, In order for there to be no danger of such a short circuit, to incorporate further the cooling method with which good electrical insulation properties are maintained whether it encounters heavy rain or passes through a deep puddle, and to mount, it shall be constituted compactly.

[0010]This invention was made in consideration of the technical technical problem like the above, and, [the purpose of this invention] It is constituted simply and compactly, and under a severe condition, contamination of a fuel cell stack is prevented, electrical insulation properties are kept good, and it is in providing further the solid polyelectrolyte form fuel cell which reaction

fever is taken out efficiently and collected from a fuel cell stack.

[0011]

[Means for solving problem]In a solid polyelectrolyte form fuel cell in order to attain the above-mentioned purpose, [in this invention] (1) a fuel cell stack which laminates two or more single batteries formed using solid polymer electrolyte membrane -- or, A fuel cell stack which laminates two or more above-mentioned single batteries and two or more members for humidification is allocated in an inside of an airtight container, Suppose that electrical-insulation-properties fluids, such as silicone oil which makes the main ingredients an electrical-insulation-properties fluid, for example, JIMECHIRU silicone, or methylphenyl silicone, or fluorocarbon, are filled to space which encloses a fuel cell stack in this airtight container.

[0012](2) Use having a circulation cooling system of the further above-mentioned electrical-insulation-properties fluid, circulating an electrical-insulation-properties fluid between the above-mentioned airtight container and a heat exchanger installed out of an airtight container, and making it cool in a heat exchanger in the above (1).

(3) In the above (2), when it reaches more than working temperature with a specific temperature of a fuel cell stack, use circulating the above-mentioned electrical-insulation-properties fluid.

[0013]It is connected via an insulating pipe which consists of electrical-insulation-properties materials, such as Ceramics Sub-Division and resin, and a fuel cell stack and a piping system which supplies fuel gas, oxidant gas, and a refrigerant and is discharged are insulated electrically. Therefore, as shown in above (1), a fuel cell stack is allocated in an inside of an airtight container, and if an electrical-insulation-properties fluid is filled to space in an airtight container which encloses this fuel cell stack, a fuel cell stack will be electrically insulated with the exterior containing an airtight container. since especially insulation performance of electrical-insulation-properties fluids, such as silicone oil which makes JIMECHIRU silicone or methylphenyl silicone the main ingredients, or fluorocarbon, is boiled markedly and is excellent compared with air or water, crevices between a fuel cell stack and an airtight container may be few. Therefore, a size of an airtight container may be small and can be constituted compactly. Since a severe gas seal structure is taken a fuel cell stack so that reactant gas which flows through an inside may not leak outside, even if it allots into an electrical-insulation-properties fluid, there is no possibility of an electrical-insulation-properties fluid leaking and causing a trouble into a fuel cell stack.

[0014]If it uses circulating this electrical-insulation-properties fluid between an airtight container and the heat exchanger installed out of the airtight container as shown in above (2), and making it cool in a heat exchanger, Since the reaction fever produced in the fuel cell stack is taken out out of an airtight container and is efficiently collected in a heat exchanger with an electrical-insulation-properties fluid, a device with high heat recollection efficiency is

constituted. Since reaction fever is promptly taken out out of an airtight container with an electrical-insulation-properties fluid, it is not necessary to insulate the airtight container in particular that stored the fuel cell stack. Therefore, it is not necessary to cover with thermal insulation, and can constitute compactly like the conventional device.

[0015]When it has the circulatory system of an electrical-insulation-properties fluid like the above and is made to cool in a heat exchanger, temperature will be low, a fuel cell stack will be superfluously cooled immediately after little starting of generating heat, and a long time will be taken to reach rated temperature. Therefore, if it uses circulating the above-mentioned electrical-insulation-properties fluid when it reaches more than the working temperature whose temperature of a fuel cell stack is specific as shown in above (3), Since cooling of a fuel cell stack is suppressed at the time of low starting of temperature and a rise in heat becomes early, starting time will be shortened and it can operate efficiently.

[0016]Since a fluid with the as high flash point as 200 - 300 ** can choose easily with electrical-insulation-properties fluids, such as JIMECHIRU silicone and methylphenyl silicone, there is no danger of ignition at the solid polyelectrolyte form fuel cell operated at the temperature below 100 **. [the fuel cell of methods other than a solid polyelectrolyte form fuel cell] . [for the Reasons of the seal material which can be sealed completely / in order that working temperature may use 190 - 1000 **, a high thing, and strong corrosive phosphoric acid as an electrolyte by a phosphoric acid form fuel cell especially / not being obtained] It is difficult to take the composition which immerses a fuel cell stack into an electrical-insulation-properties fluid as mentioned above.

[0017]

[Mode for carrying out the invention]Hereafter, this invention is explained using a work example.

<Work-example 1> drawing 1 is an exploded perspective view showing the basic composition of the fuel cell stack of the 1st work example of the solid polyelectrolyte form fuel cell of this invention, and an airtight container.

[0018]The fuel cell stack 1 which comprised this example by laminating two or more single cells is allocated in the inside of the airtight container 2 of the shape of a metal rectangle, and is being fixed to the airtight container 2 by the insulating spacer 3 made from alumina, and the insulating bolt made of resin which is not illustrated. JIMECHIRU silicone liquid (Shin-etsu silicone company make KF96H) is filled as the electrical-insulation-properties fluid 4 in the space inside the airtight container 2 which encloses this fuel cell stack 1. In drawing 1, in order to display easily, the electrical-insulation-properties fluid 4 is displayed only on the space of the lower half part inside the airtight container 2, but the electrical-insulation-properties fluid 4 is filling all the space that encloses the fuel cell stack 1 inside the airtight container 2.

[0019]The fuel cell stack 1 is an internal manifold method, and each two or more single cells

which constitute the fuel cell stack 1 equip the field inner circumference side part with a pair of fuel gas manifolds 11, the oxidizer gas manifold 12, and the refrigerant manifold 13, respectively. These manifolds are connected to the fuel gas piping 14, the oxidant gas piping 15, and the refrigerant piping 16 which were attached to the airtight container 2 via the insulating pipe which consists of electrical-insulation-properties materials, such as alumina or poly tetra-FURURU ethylene, and which is not illustrated. After the fuel gas which makes hydrogen the main ingredients is sent to the fuel gas manifold 11 through the fuel gas piping 14 from an external property modification device, flows through the inside of the field of each single cell of the fuel cell stack 1 and contributes to the Electrochemistry Sub-Division reaction, it is brought together in the fuel gas manifold by the side of opposite, and is taken out in the exterior of the airtight container 2. Similarly the air sent by the air compressor through the oxidant gas piping 15 is supplied to the oxidizer gas manifold 12, and it flows through the inside of the field of each single cell, and contributes to the Electrochemistry Sub-Division reaction. With a pump, the cooling water as a refrigerant is sent to the refrigerant manifold 13 via the refrigerant piping 16, and cools the fuel cell stack 1.

[0020]In this composition, the fuel cell stack 1 is fixed to the airtight container 2 with the insulating spacer 3 as mentioned above, Since the electrical-insulation-properties fluid 4 is filled in the space inside the airtight container 2 which an insulating pipe is built into piping of gas and a refrigerant which carries out feeding and discarding to the fuel cell stack 1, and encloses the fuel cell stack 1, the electric insulation of the fuel cell stack 1 is completely carried out to the exterior. Since the fuel cell stack 1 is allotted to the inside of the airtight container 2, drawing 2 which is polluted under a severe condition and which can be stabilized and operated without being afraid is a distribution diagram showing the basic composition of the circulation supply system of the electrical-insulation-properties fluid 4 currently filled by the airtight container of this example. As shown typically, the fuel cell stack 1 is stored inside the airtight container 2, and the JIMECHIRU silicone liquid as the electrical-insulation-properties fluid 4 is filled in the space in the airtight container 2 which encloses the fuel cell stack 1. Fuel gas, oxidant gas, and cooling water are supplied to the fuel cell stack 1 via the fuel gas piping 14, the oxidant gas piping 15, and the refrigerant piping 16 which were attached to the airtight container 2. The heat exchanger 5, the oil tank 6, and the pump 7 are built into the circulation supply system of the electrical-insulation-properties fluid 4, and the JIMECHIRU silicone liquid as the electrical-insulation-properties fluid 4 circulates through this circulation supply system with the pump 7. That is, it flows through the circumference of the fuel cell stack 1 in the airtight container 2, and after it is sent to the heat exchanger 5 and cooled by heat exchange with external intercooling water, the electrical-insulation-properties fluid 4 which absorbed and carried out the rise in heat of the generation of heat accompanying the Electrochemistry Sub-Division reaction is returned to the oil tank 6, and is again sent to the inside of the airtight

container 2.

[0021]Therefore, in this composition, since it will be cooled by the both sides of the cooling water which flows through an inside, and the electrical-insulation-properties fluid 4 which flows through the circumference and the fuel cell stack 1 will be held at predetermined working temperature, heat recollection is carried out efficiently.

<Work-example 2> drawing 3 is a distribution diagram showing the basic composition of the circulation supply system of the electrical-insulation-properties fluid 4 currently filled by the airtight container of the 2nd work example of the solid polyelectrolyte form fuel cell of this invention.

[0022]The fuel cell stack 1 of this example and the composition of the airtight container 2 are the same as the composition of the 1st work example shown in drawing 1. The difference with the 1st work example of this example is in the composition of the circulation supply system of the electrical-insulation-properties fluid 4. That is, by this example, the air-cooled heat exchanger 8 provided with the fan 9 for heat exchange promotion so that drawing 3 might see is used to the heat exchanger 5 of the water cooled system having been used in the 1st work example. After the temperature of the fuel cell stack 1 rises to prescribed temperature, the starting time of a device can be shortened by using operating this fan 9. In the case of the solid polyelectrolyte form fuel cell for movement, it is good also as rotating this fan 9 by the wind received with a run. Although methylphenyl silicone liquid (KF96H by GE Toshiba Silicones Co., Ltd.) is used as the electrical-insulation-properties fluid 4 in this example, the JIMECHIRU silicone liquid used in the 1st work example may be used. The methylphenyl silicone liquid of this example may be used as the electrical-insulation-properties fluid 4 of the 1st work example.

[0023]<Work-example 3> drawing 4 is an exploded perspective view showing the basic composition of the fuel cell stack of the 3rd work example of the solid polyelectrolyte form fuel cell of this invention, and an airtight container. There is the feature of the composition of this example in the cylindrical airtight container 2A being used, and accompanying and the insulating spacer 3 and the insulating spacer 3A in which shape differs a little being incorporated as an airtight container which stores the fuel cell stack 1, instead of the airtight container 2 of the shape of a rectangle of the 1st work example. In this example, methylphenyl silicone liquid (TSF-431 by GE Toshiba Silicones Co., Ltd.) is used as the electrical-insulation-properties fluid 4. Since the coagulating point is as low as -70 **, electrical-insulation-properties fluids, such as this methylphenyl silicone liquid, do not have a possibility of freezing in a practical environmental condition and damaging the fuel cell stack 1, piping, etc., and since the disposal which extracts this electrical-insulation-properties fluid is unnecessary also when carrying out prolonged storage, it becomes easy [a maintenance]. Like drawing 1, also in drawing 4, in order to display easily, the electrical-insulation-properties fluid 4 is displayed

only on the space of the lower half part inside the airtight container 2A, but the electrical-insulation-properties fluid 4 is filling all the space that encloses the fuel cell stack 1 inside the airtight container 2A.

[0024]Since these electrical-insulation-properties fluids play the role of keeping-warm material in using the fuel cell which filled and constituted the electrical-insulation-properties fluid like the above in the airtight container like the composition of drawing 1 or drawing 4 in a cold district, the temperature fall at the time of suspending a device can be made loose. For this reason, since the utility time of the anti-freeze heater in a stop period is shortened, energy saving can be attained. Since the freezing point also maintains viscosity, these electrical-insulation-properties fluids do not need to perform the measure of anti-freeze, and become easy [a maintenance].

[0025]

[Effect of the Invention]As stated above, in this invention since (1) solid-polyelectrolyte type fuel cell is constituted like a description in Claim 1, Under a severe condition, contamination would be prevented, electrical insulation properties will be kept good, further, the necessary size for an electric insulation and heat insulation contracts sharply, it will be constituted compactly and a solid polyelectrolyte form fuel cell also with an easy maintenance will be obtained.

[0026](2) The solid polyelectrolyte form fuel cell from which generating heat is collected very efficiently will be obtained by constituting like Claim 2. For example, 1 kW of exchange outputs are received in a 1-kW power generator for home use. Although about 1.5-kW reaction fever arose and the 100 W grade (abbreviation 7%) had dissipated by heat dissipation from a fuel cell conventionally, By using the composition of this invention, the power of this amount of heat dissipation which the whole quantity will be collected mostly and is a new pump was able to be deducted, and combined efficiency was able to be improved abbreviation 3%. In the 30 kW power generator for movement, the generated not less than 40-kW quantity of heat can be easily discharged now irrespective of an environmental condition.

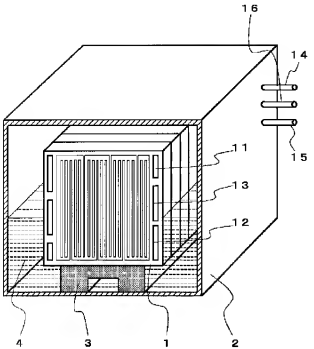
[0027](3) The solid polyelectrolyte form fuel cell which can be started in a short time will be further obtained by constituting like Claim 3. That is, as for abbreviation 20 % shortening, time until the rise in heat of the fuel cell stack after a starting start is brought forward and a rated output is obtained by this composition will be made.

[Brief Description of the Drawings]

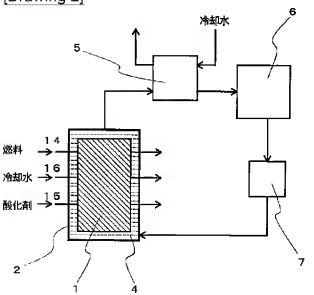
[Drawing 1]The exploded perspective view showing the basic composition of the fuel cell stack of the 1st work example of the solid polyelectrolyte form fuel cell of this invention, and an

airtight container
[Drawing 2]The distribution diagram showing the basic composition of the circulation supply system of the electrical-insulation-properties fluid currently filled by the airtight container of the 1st work example
[Drawing 3]The distribution diagram showing the basic composition of the circulation supply system of the electrical-insulation-properties fluid currently filled by the airtight container of the 2nd work example of the solid polyelectrolyte form fuel cell of this invention
[Drawing 4]The exploded perspective view showing the basic composition of the fuel cell stack of the 3rd work example of the solid polyelectrolyte form fuel cell of this invention, and an airtight container
[Drawing 5]The mimetic diagram showing the basic composition of the general cell of a solid polyelectrolyte form fuel cell
[Drawing 6]The partial side view showing the example of composition of a fuel cell stack
[Explanations of letters or numerals]
1 Fuel cell stack
2 2A Airtight container
3 and 3A insulating spacer
4 Electrical-insulation-properties fluid
5 Heat exchanger (water cooled system)
6 Oil tank
7 Pump
8 Heat exchanger (air cooling)
9 Fan
11 Fuel gas manifold
12 Oxidizer gas manifold
13 Refrigerant manifold
14 Fuel gas piping
15 Oxidant gas piping
16 Refrigerant piping

[Drawing 1]



[Drawing 2]



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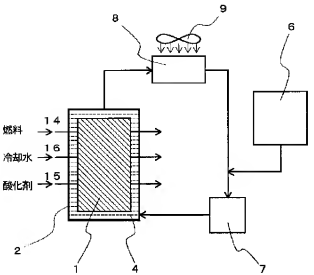

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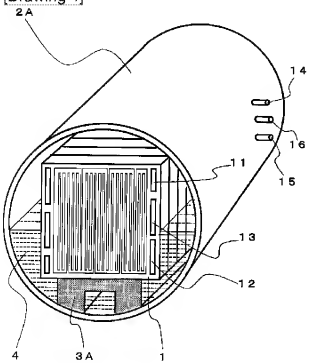
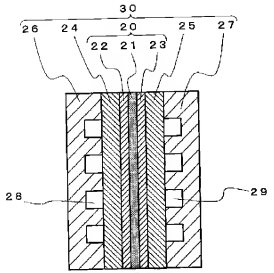
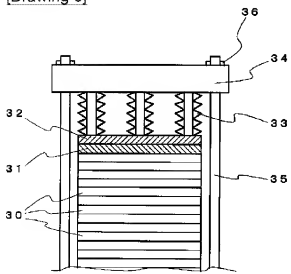


[Drawing 5]



[Drawing 6]



---------- [Written Amendment]

[Filing date]Heisei 13(2001) June 19 (2001.6.19)

[Amendment 1]

[Document to be Amended]Description

[Item(s) to be Amended]0019

[Method of Amendment]Change

[Proposed Amendment]

[0019]The fuel cell stack 1 is an internal manifold method, and each two or more single cells

which constitute the fuel cell stack 1 equip the field inner circumference side part with a pair of fuel gas manifolds 11, the oxidizer gas manifold 12, and the refrigerant manifold 13, respectively. These manifolds are connected to the fuel gas piping 14, the oxidant gas piping 15, and the refrigerant piping 16 which were attached to the airtight container 2 via the insulating pipe which consists of electrical-insulation-properties materials, such as alumina or polytetrafluoroethylene, and which is not illustrated. After the fuel gas which makes hydrogen the main ingredients is sent to the fuel gas manifold 11 through the fuel gas piping 14 from an external property modification device, flows through the inside of the field of each single cell of the fuel cell stack 1 and contributes to the Electrochemistry Sub-Division reaction, it is brought together in the fuel gas manifold by the side of opposite, and is taken out in the exterior of the airtight container 2. Similarly the air sent by the air compressor through the oxidant gas piping 15 is supplied to the oxidizer gas manifold 12, and it flows through the inside of the field of each single cell, and contributes to the Electrochemistry Sub-Division reaction. With a pump, the cooling water as a refrigerant is sent to the refrigerant manifold 13 via the refrigerant piping 16, and cools the fuel cell stack 1.

[Amendment 2]

[Document to be Amended]Description

[Item(s) to be Amended]0020

[Method of Amendment]Change

[Proposed Amendment]

[0020]In this composition, the fuel cell stack 1 is fixed to the airtight container 2 with the insulating spacer 3 as mentioned above, Since the electrical-insulation-properties fluid 4 is filled in the space inside the airtight container 2 which an insulating pipe is built into piping of gas and a refrigerant which carries out feeding and discarding to the fuel cell stack 1, and encloses the fuel cell stack 1, the electric insulation of the fuel cell stack 1 is completely carried out to the exterior. Since the fuel cell stack 1 is allotted to the inside of the airtight container 2, drawing 2 which is polluted under a severe condition and which is not feared, and can be stabilized and operated is a distribution diagram showing the basic composition of the circulation supply system of the electrical-insulation-properties fluid 4 currently filled by the airtight container of this example. As shown typically, the fuel cell stack 1 is stored inside the airtight container 2, and the JIMECHIRU silicone liquid as the electrical-insulation-properties fluid 4 is filled in the space in the airtight container 2 which encloses the fuel cell stack 1. Fuel gas, oxidant gas, and cooling water are supplied to the fuel cell stack 1 via the fuel gas piping 14, the oxidant gas piping 15, and the refrigerant piping 16 which were attached to the airtight container 2. The heat exchanger 5, the oil tank 6, and the pump 7 are built into the circulation supply system of the electrical-insulation-properties fluid 4, and the JIMECHIRU silicone liquid as the electrical-insulation-properties fluid 4 circulates through this circulation supply system

with the pump 7. That is, it flows through the circumference of the fuel cell stack 1 in the airtight container 2, and after it is sent to the heat exchanger 5 and cooled by heat exchange with external intercooling water, the electrical-insulation-properties fluid 4 which absorbed and carried out the rise in heat of the generation of heat accompanying the Electrochemistry Sub-Division reaction is returned to the oil tank 6, and is again sent to the inside of the airtight container 2.

[Translation done.]